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19 August 1982 Vol 1 No 18

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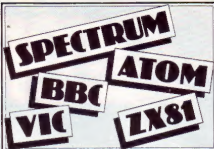
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How to submit articles

Articles which are submitted for publication
should not be more than 1000 words long.

All submissions should be typed and a double
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Programs should, whenever possible, be
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At present we cannot guarantee to return
every submitted article, so please keep a copy.

Accuracy

Popular Computing Weekly cannot accept any
responsibility for any errors in programs we
publish, although we will always try our best to
make sure programs work.

This Week



Cover illustration by Tachian Inasa

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Editorial

Microcomputers are becoming more sophisticated every year. Colour and sound facilities no longer excite the user as once they did. They are rapidly being taken for granted.

Users are now looking forward to micros with flat screen displays and the ability to up and download telesoftware. Video disc interfaces and CP/M operating systems will soon be expected as standard.

The next generation of micros are likely to be different in kind to their predecessors. No longer will mainframe operators be able to refer sneeringly to micros as "toys".

The Japanese are currently working on a fifth generation supercomputer that they hope will think and speak like a man. How long before a fifth generation micro appears on the scene?

E F Schumaker first propounded the theory that "small is beautiful". As far as micro enthusiasts are concerned, small is not merely beautiful, it is also better.

Next Week



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BLOCK PUBLISHERS would like to hear from readers with a view to publishing their programs for the Spectrum and BBC Microcomputers. Other ideas for books also considered. Castle House Publications Ltd, 27 London Road, Turbidge Wells, Kent TN1 1BX.

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Spectrum delay prompts gift offer

THOSE waiting for a ZX Spectrum can expect to have to wait at least 12 weeks before delivery of their orders.

This is the situation described in an open letter released by Clive Sinclair.

He explains that the problems have been due to initial production delays and orders far exceeding expectations.

Production of the machine is now apparently running smoothly at 5,000 units per week and should rise over the coming months. The letter continues: "We are confident that our order backlog will be cleared by the end of September."

Sinclair Research will be writing to all of its waiting customers, explaining the position and offering them all an immediate refund.

Those customers who choose to continue to wait will receive a £10 voucher.

The £10 voucher can be used against the cost of a ZX Printer or exchanged for a pack of five rolls of printer paper.

Clive Sinclair concludes with hope that the current difficulties will be viewed in the context of Sinclair's successful delivery of more than half a million computers in the last two years.



NewBrain... 500 units per week.

Grundy steps up its micro production

THE NewBrain micro from Grundy Business Systems is now in high-volume production following its launch in May.

More than 500 units per week are being produced at the special assembly line at Thorn EMI Datatech in Feltham.

The plant has the capability to manufacture up to 3,000 micros per week and its automated printed-circuit board component insertion and testing equipment can handle more than 4 million components per month.

The announcement of the production figures was made as Information Technology Minister, Kenneth Baker, opened the new Grundy research and development laboratories at Cambridge.

Cut-price Texas micro signals US market war

TEXAS Instruments in the US has logged £38 off the price of its TI99/4A microcomputer so that is now sells at £115.

This makes the machine cheaper than its rival, the Commodore Vic20 which sells for £140 in the US.

The move also makes the TI99/4A a direct competitor to the Sinclair Spectrum.

However, it is not clear when the ZX Spectrum will be launched in America.

A spokesman for Sinclair Research said that it was hoped to market the machine there in early 1983.

This expectation is dependent on several factors. An American launch will not be contemplated until the UK production difficulties are sorted out and demand in the home market has settled down.

Even then, if the Spectrum passes the rigorous US product tests, it is not clear if Sinclair will be able to sell the machine there.

Under Sinclair Research's far-reaching agreement with Timex US, the latter has free rein to market Sinclair micros as they are, to modify them (as in the case of the TD1000 now being sold which is a 2K version of the ZX81) or to produce an entirely different computer using Sinclair technology.

The terms of the agreement allow Sinclair Research's US subsidiary to continue to sell machines only as long as Timex US sales are below a certain threshold level. Beyond this level their sale is prohibited.

This cut-off applies not just to the equivalent micro, but to the whole range.

So, if Timex sales of their ZX81 adaptation have exceeded this threshold level, then Sinclair Research will be prohibited from launching the Spectrum in the US.

£50 ZX81

Sinclair have cut the price of their ZX81 by £20 from £69.95 to £49.95. This follows a drop in the price of their 16K Ram pack, from £49.95 to £29.95, in April.



Holding up to seven peripheral cards... the new Texas box.

A new box of tricks

A NEW peripheral expansion box has been launched for the TI99/4A machine by Texas Instruments.

The system, price £190, is capable of housing up to seven peripheral board-type cards.

The unit also has space within it to fit a single 5¼ inch floppy disc drive.

The plug-in cards available for use with the unit include a 32K Ram expansion, one parallel, two RS232 and modem interfaces, and extended Basic, Pascal and various 'command module' software cards.

Two additional disc drives can be connected to the unit.

The gospel according to Clive

CLIVE Sinclair predicts that, by the end of the century, there will be more than 10 million people unemployed in Britain, with only 10 per cent of the population employed in manufacturing industries.

These remarks formed part of a speech delivered by Sinclair to members of Mensa at their third annual symposium in Cambridge.

The qualification for membership of Mensa is a high IQ. The most intelligent two per cent of the population are eligible and the group has 60,000 members world-wide, some 8,000 of whom are UK residents.

Sinclair, founder of Sinclair Research, is currently the Chairman of British Mensa.

The address he gave at the symposium examined the so-called 'Golden Ages' of mankind. The conclusion Sinclair drew was that many of the conditions he identifies as necessary for a Golden Age are developing in our present society.

He believes that there is shortly to be a hundred-fold reduction in the cost of data manipulation, which will be coupled with a dramatic decline in the manpower requirements of industry.

"I believe," said the Mensa chairman, "that positions in industry are inimical to the human spirit." He continued: "A move away from this present type of organisation will restore the potential of the individual."

Such a change would result in a reaffirmation of class distinctions and lead to a revival of traditional artistic and creative patronage.

"Early in the next century we will have made intelligent machines, ending for all time the current pattern of drudgery. It may well be," he said, "that western civilisation is just about to flower."

Letters

write to Letters, Popular Computing Weekly, Hobhouse Court, 19 Whitcomb Street, London WC2

Yes, you too can make the grade

Congratulations to David Lawrence on his excellent renumbering program for the ZX81 (PCW July 1). This, along with Nick Hampshire's 3D Spectrum Graphics, was one of the best programs you have ever published.

I felt that those people who have upgraded to a ZX Spectrum should not be left out. So, here are details of how to convert the renumbering program.

Change these lines:

```
9660 LET X1=23755
9671 IF PEEK (X1)=14 THEN GO
    TO 9674
9676 LET BASE=10
9677 LET X1=23755
9690 DIM B(4) LET B(5)=LEN
    STR$ BASE TO =BTR$ BASE:
    FOR J=1 TO 4
9691 POKE VAL T$(TO
    =4)+J CODE B(J)
9693 LET BYTE1=BASE-256=INT
    (BASE/256)
9694 LET BYTE2=INT (BASE/256)
9695 POKE MEMORY+8 BYTE1
9697 POKE MEMORY+9 BYTE2
```

AND delete line 9998.

The program will now run on a standard Spectrum. Also, this version can handle a BASE value of less than four digits. I hope that someone will find these alterations useful.

Bill Longley
388 Ipswich Road
Colchester
Essex

But no one's without fault

I must correct the impression given by Sinclair Research in your letters page of July 8. Their claim not to have sold a faulty ZX81 after July '81 is incorrect. I bought mine in September '81 and it had a faulty Rom.

The unit was replaced, but I now seem to have another problem. This program was written to extract cube roots. It works fine on some numbers, but try inputting 27 or three and then see what happens.

```
10 Input A
20 Input B
30 Let C=((A/B)/B)+B/2
40 FC=B THEN GOTO 30
50 Let B=C
```

```
60 Goto 30
70 Print
80 Print "Cube root is "; C
```

Perhaps some reader with more knowledge of maths than I have will be able to solve the problem.

W McLaren
70 Lyndale Road
Whorlery
Coventry CV5 8AQ

So just show your character

I am writing to point out a useful addition to the program entitled 'Character Plot' in PCW July 1, on page 15. Not everyone wishes to feed the new characters directly from tape into their programs as a series of peeks and pokes. Some people prefer to have the information in data statements.

Add the following line to the program:

```
425 FOR K=1 TO N:FOR J=8 TO
    7:PRINT:PRINT A(K,J):NEXT
    NEXT
```

the program will then print out the numerical information necessary to fill a data statement in a program, for the new character created. It is best to use the program to compile one new character at a time when doing this, otherwise the string of numbers printed out will extend off the screen. An excellent program this. Very useful. Congratulations to the author.

C Cartanach
11 North Ridge
Dunstable Park
Welwyn
Hertfordshire AL6 9RD

And we'll try to show ours

I have taken your magazine since it started and look forward to collecting my copy on Wednesdays. I am pleased to see it is not full of advertisements.

I am a Vic20 user, just started in computing and enter the programs you publish. However, I would say that the printing of your programs leaves a lot to be desired. Would it be possible to improve them by darker printing? As you are aware, it only

needs one letter to be unreadable and the program will not run.

E Mowlem
6 Leedam Road
Bournemouth
Dorset BH10 6HP

Otherwise it's really not fair

I have a regular order for your magazine placed with my newsagent. Up until now I have generally been very satisfied with it. But, your issue of July 15 disappointed me a great deal.

Being a Vic20 owner, I was delighted to see the number of programs included for my machine. However, having struggled to type in 'Spy Hunt' and having almost ruined my sight to decipher 'Vic' (an excellent program it turned out to be), I found it totally impossible to do anything with 'Hangman' and 'Anagram Birds'. Would it be possible to send me a listing of these programs, particularly 'Anagram Birds'?

I am pleased to see a greater leaning towards educational uses as I have two children for whom these would be extremely useful — hence my delight with 'Vic'.

Before finishing, would it be possible to warn any would-be purchasers of Tim Hartnell's *Symphony for a Melancholy Computer* to think again? It is so full of errors that the Office of Fair Trading might do well to consider whether it is fit for the purpose for which it is intended.

Jim Corrigan
23 Brook Avenue
Uppermill
Oldham
Lancashire OL3 6DR

We have received a number of letters complaining about the quality of our Vic listings (PCW July 22). These criticisms are justified, particularly in regard to our July 15 issue.

As we have already explained, all our programs are reproduced directly from the original listings so as to minimise the number of errors. Vic printer listings seem to reproduce very badly. However, by

choosing darker listings wherever possible and by reproducing them as large as possible, we are solving the problem. The Vic listings in PCW July 29 and August 5 are a substantial improvement.

We will be happy to supply you with a copy of 'Anagram Birds', but I am afraid we have no other copies of 'Hangman'.

And the answer is a lemon!

I ordered my BBC micro in December and after the customary wait received it in 'average' condition. Not quite dead on arrival, as many have been, but the keyboard had fallen out. This problem sorted out, I soon found strange faults with the machine that proved to be caused by overheating.

On being informed of a local agent, I duly took them my micro on April 26. It was nearly two weeks before they even looked at it. They informed me it had been sent back to Acorn.

On June 11 my micro was returned absolutely untouched — nothing had been done to it, it still overheated. On June 14, I returned it to the agent. I am still waiting.

To all those who had a long wait or are waiting now — should your BBC micro go wrong you too could be like me waiting three months for your micro to be returned. You will also receive a card guaranteeing your micro for six months — will my guarantee run out before my micro is returned?

What with defective ULA's, the 'provisional' user guide, an operating system that does not follow the specification and a failure rate (at my computer club anyway) of around 50 per cent, I think the BBC and Acorn should christen the BBC micro, as I have done, 'The Lemon'.

I also suggest the people I keep phoning at the Repair Centre should be called the *Lemonades*.

P Webb
30 Walpole Road
Runcorn
Cheshire

Alien Attack

A 1K machine code game for ZX81 by
Jeff Naylor

Anyone with a Sinclair ZX81 without some form of memory expansion will admit that although moving graphical games are possible in Basic, they rarely satisfy avid arcade machine players with either their speed or complexity. The addition of more memory allows complex games, but those graphics are still slow to the point of boredom.

Machine code, on the other hand, by talking directly to your computer's microprocessor, speeds things up to the extent that delay loops are needed to give us humans a chance. I have written a machine code game that imitates the original Space Invaders arcade machine which has given so many people pleasure, ground-down teeth, and a shortage of loose change.

This 1K version still has limitations; no shields to hide under, and the score not appearing until the end, for example. The invaders do speed up as their numbers reduce and, if you manage to wipe them all out, another bunch appears, twice as fast as before. The game can also be tailored to your own level of skill, with overall speed, the number of aliens and the speed of their firing, all easily adjusted.

One problem with machine code programs is how boring they are to enter; another is that mistakes can creep in at any stage, and when that happens debugging there is no laughing matter. My listing consists of two columns — one in hexadecimal, the other in decimal, so as to provide a cross-reference.

You have the choice as to which to load — decimal is easier if you don't know your way round a keyboard too well, while it is good practice and a bit quicker, once you have got the hang of it, to use the hexadecimal codes.

I make no attempt to explain the nuts and bolts of the program. If you do not understand machine code I recommend the book *Mastering Machine Code* on your ZX81 by Toni Baker. The program

was developed with no knowledge other than that gained from the book.

The basic ZX81 has less than 900 free bytes of Ram, and to fill a screen would use 729 bytes, so the program uses alternate lines of the screen except all the top and bottom. This gives the impression of using the whole screen, but uses only 409 bytes.

The Sinclair graphics allow only a rough approximation to the original game, and those symbols used are chosen with care — only invaders or explosions can have odd character codes, and everything on the bottom line must have a second hex digit of 6 — is inverse A has a hex character code of A6; you can look up the others in the back of the Sinclair manual.

To load the program first enter Fast as a command, as the first part is very tedious indeed. Enter the first line as: 1 REM (347 zeros).

The 347 zeros are reserving space for the machine code. Don't bother counting the zeros exactly until you have entered ten lines (32 zeros per whole line) but enter the remaining 27 with care, as you are on the limits of memory, and will have difficulty getting into the Edit mode if you make a mistake.

Having typed the Rem statement, press Newline then return to the slow mode. It is probably worth saving on tape — just in case. Now enter the loading program. Listing 1 is for decimal, Listing 2 for hex. These will poke the required machine code commands into line 1.

Run the program, and in response to the first input prompt, enter 16514 as the starting address. Using decimal, enter only one code at a time, starting with the decimal code for 16514. Using hex you may enter up to eight codes before pressing Newline. If you enter more you will probably get a 4 error code; don't panic just enter Cont as a command. If you find you have gone astray, break out by enter-

ing any single letter other than "A" and rerun the program, starting at an address you know to be correctly loaded.

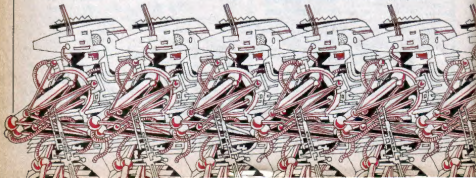
When the whole listing is loaded, save it a couple of times on tape, have a cup of tea, and if it's past midnight — GO TO BED!

Approaching your Sinclair suitably refreshed, reload the story so far, and delete all the Basic lines except line 1. Type in Listing 3 and run the program. If you have loaded the machine code correctly, forty two space invaders will appear and start to move about in a menacing manner. Don't touch anything — after they have lurched backwards and forwards across the screen twice they will all move down two lines.

By now you should have noticed their missiles (flying brackets) and when one hits what purports to be your space-ship in the bottom left-hand corner, the screen will clear and your score — 000 — will appear in the middle. If nothing stranger has happened, run the program again. Using the top row of keys.

The key 6 or any to the right of it should move your ship to the right — key 5 or any to its left will let you scurry back into the corner. Now press the shift key — and if an alien is in the path of your plasma bolt — or, to the technically minded, flying colon — it should explode. If the program has not crashed by now then start playing the game to test it properly. If something has gone wrong then turn the power off and on, and reload the program, even if you don't appear to need to, as the machine code may have corrupted itself.

Amend your Basic program so as to check the code as shown in the listing. Run the program and enter the starting address. Pressing any key other than Break will scroll the code up the screen. Work through carefully as there only needs to be one wrong character to cause chaos. When found, correct any mistakes by using POKE as a direct command.



Programming

Out for the count and seeing stars!

David Nowotnik shows school children how to add and subtract.

The first hurdle in learning elementary arithmetic is teaching the child to count. Once children have learnt to count, they can associate the number with its character on the keyboard. The numbers one to nine present no great problem, as they are one-digit numbers which appear in order on the top row of the keyboard. Two-digit numbers presented a little more difficulty. The following short routine was of assistance:

```
10 PRINT "COUNT"
20 FOR I=1 TO 12
30 PRINT
40 PRINT TAB 4;
50 FOR J=1 TO I
60 PRINT " ";
70 NEXT J
80 IF INKEY="" THEN GOTO 90
90 NEXT I
```

The child can count the stars in each line and, with practice, associate the number at the beginning of the line with the number counted. Figure 1 contains a more complex version of this program.

In 'Count', the number of stars is selected at random. No number is given, and the child is expected to add up the stars and enter the correct total. When the child gives his answer, the computer counts the stars, one-by-one, to check if the child was right. Seeing the computer counting helps the child to get it right.

The next stumbling block in arithmetic is subtraction. The way this is put across to the child will vary from school to school. My youngster learnt it as 'the difference between ...'. The program he used to conquer this concept is listed in Figure 2.

Two numbers between one and 20 are selected at random. These numbers are shown in two ways; as the number, and as a string of stars. The idea is to recognise that the difference between the two numbers is the sum of the stars which do not overlap.

If the child gets the answer wrong, the stars which do overlap are converted to inverse video to reinforce the idea that those parts of the two rows are the same. The difference is now more clearly marked, and the child is asked to try again.

Fig 1

```
10 RAND
20 PRINT AT 1,6;"CAN YOU COUNT?"
30 LET R=INT (RND*15+5)
40 PRINT AT 5,4;
50 FOR I=1 TO R
60 PRINT "*"
70 NEXT I
80 PRINT AT 12,3;"HOW MANY STARS ARE THERE?"
90 INPUT A
100 PRINT AT 14,6;"YOUR ANSWER WAS "A"; IS IT RIGHT?"
104 FOR J=1 TO 30
106 PRINT J
110 FOR I=1 TO J
120 PRINT AT 6,4+R-1;" "
130 FOR K=1 TO 10
140 NEXT K
150 PRINT AT 6,4+R-1;"*"; AT 8,0;I
160 FOR J=1 TO 25
170 NEXT J
180 NEXT I
190 IF A=R THEN GOTO 250
200 PRINT AT 10,6;"YOU WERE RIGHT"
210 GOTO 300
250 PRINT AT 10,6;"THE RIGHT ANSWER WAS "R"
300 FOR I=1 TO 200
310 NEXT I
320 CLS
330 GOTO 30
```

Fig 2

```
10 RAND
20 PRINT AT 1,2;"THE DIFFERENCE BETWEEN....."
30 LET R=INT (RND*20+1)
40 LET S=INT (RND*20+1)
50 PRINT AT 6,1;R;AT 8,5;S
60 GOSUB 200
70 PRINT AT 8,0;"AND"
80 PRINT AT 10,1;S;AT 10,5;R
90 GOSUB 250
100 PRINT AT 14,2;"WHAT IS THE DIFFERENCE?"
110 INPUT A
120 IF A=ABS(R-S) THEN GOTO 150
125 PRINT AT 10,8;"TRY AGAIN"
130 LET B=R*(R<S)+S*(R>S)
132 FOR I=1 TO B
135 PRINT AT 6,4+1;"*";AT 10,4+1;"*"
140 NEXT I
145 GOTO 110
150 PRINT AT 10,8;"THAT'S RIGHT"
160 FOR I=1 TO 50
170 NEXT I
180 CLS
190 GOTO 20
200 FOR I=1 TO R
210 PRINT "*"
220 NEXT I
230 RETURN
250 FOR I=1 TO S
260 PRINT " ";
270 NEXT I
280 RETURN
```

Street Life

The man who wants to be a millionaire

David Kelly talks to Steve Vickers, co-designer of the ZX Spectrum.

Steve Vickers was heavily involved in the design of the ZX Spectrum. He wrote most of the Spectrum's Rom and manual.

But he did not touch a computer until he was 16. His father gave him the first book on Basic, written by the two researchers at Dartmouth College who developed the language.

"When I was in primary school," grins Steve, "the only thing I was sure about was that I was going to be a doctor."

"I wanted a PhD — after that I was convinced that I would be free to do whatever I wanted."

"I didn't plan a career in computers. In fact, I don't think I planned anything at all. When I left Leeds University, after gaining a PhD in mathematics, a friend of mine said that micros were the great thing so I wrote round and started applying for jobs."

Steve got involved with Sinclair completely by accident. "I applied to Sinclair and they turned me down — they said they had no vacancies. In the end I got a job working for a software house called Nine Tiles."

It was not until after Steve began working for them that he discovered that Nine Tiles were contracted by Sinclair Research to write all their software and firmware.

When he joined Nine Tiles the ZX80 had just been launched and they were completing work on the ZX81.

In July 1981 Sinclair began planning the Spectrum. In due course, Nine Tiles began work on the firmware. With only six people on the staff, Steve was chosen to write the coding.

Sinclair laid down the basic specifications of the new machine. It was to have colour, sound and, to save time, would use essentially the same firmware as the ZX81. The keyboard and cassette interface also needed to be improved.

During the six months that Steve worked on the Spectrum, he spent half his time at Sinclair's and half at Nine Tiles.

At Sinclair he worked with Richard Allwaser who designed the Spectrum hardware. "While Richard was building up the hardware, I'd be sorting out the software on it," says Vickers.

"King's Parade (Sinclair's) was really



Steve Vickers: "I saw how many millions Clive Sinclair was making."

the only place where I could test what I was doing."

"In such a small team — Richard and I were the only ones that worked full time on the Spectrum's development — it was easy to sort out any problems."

"Much of the ZX81's firmware was taken over to the Spectrum unmodified. We had to get the machine out quickly so the ZX81 code was altered as little as possible. That is why the Spectrum is comparatively slow — the ZX81 was always designed to save bytes, not time."

"Some things seemed to be continuing problems — like the Ink and Paper commands. Each pixel can be paper or ink but, within each character space is 8 x 8 pixels, only two colours can be shown. 'In a sense,' says Steve, 'the Spectrum has hi-res graphics with low-res colour.'"

If the Paper and Ink were the same colours in the lower part of the screen (where the cursor is), then it would have been impossible to see what was happening. "We eventually decided to make the lower part of the screen the same colour as the border," explains Steve. "It seems silly, but it took a lot of fiddling to get that to work properly."

When the design work was completed in February, Steve took a month off from his work at Nine Tiles and wrote the manual that accompanies the Spectrum.

In April this year Steve Vickers left Nine Tiles. Simultaneously, Richard Allwaser left Sinclair Research, and the two designers have set up their own company, Jupiter Cantab.

Steve is understandably somewhat reticent about their plans. "I left Nine Tiles because I wanted to be my own boss. I

saw how many millions Clive Sinclair was making and thought 'Why not us?'"

"I had always thought Richard was a good person to work with. He came up with an idea — something no one else has done — and that's what we've been busy working on."

Steve confided: "Now that it is nearly finished, we can hardly stand the tension — I'm on tenterhooks."

What's happening

Wallington Computer Club has been formed. The group meets on alternate Mondays at 7.30 pm. For more details contact Douglas Mynett, 15 Sandy Lane South, Wallington, Surrey (Tel: 647 2857).

Genius ZX81 Club has been formed to exchange programs and ideas by post. Contact Ayyaz Mehmood, 30 Webber House, North Street, Barking, enclosing a SAE for further information.

Vic-Pet Computer Club meets fortnightly at the Spread Eagle, Oakley Hay, near Corby, Northants at 7.30 pm. Contact P. Wilson, 26 North Cape Walk, Corby, Northants (Tel: Great Oakley 742622).

Northwest London Spectrum User Group is soon to be formed. Interested parties should contact Jonathan Briggs, 33 Wessex Gardens, London NW11.

Swindon ZX Users Club has been formed. The club will hold monthly meetings. For more details contact Andrew Bartlett, 47 Grosvenor Road, Swindon, Wilts (Tel: 0793 30770).

Reviews

software

Sargon 11 Chess

Commodore, 675, Alex Avenue, Slough Trading Estate, Slough, Berkshire.
Vic20, cartridge.
Price: £24.95.

This cartridge must be one of the best produced, so far, from the Commodore stable. It follows in the tradition of earlier Sargon games, and gives the player an excellent game of chess at all of the different skill levels. The response time taken by the computer is also excellent. The average reaction time ranges from two seconds upwards.

As with all Commodore cartridges, there is a screen alignment function. This cartridge also has a screen/character colour change facility which I found an added bonus.

The movement of the pieces could not be simpler. If you have a joystick then all you do is move a flashing square over the piece which you want to move and press the Fire button. Then you move the flashing square again. If you do not have a joystick, you can type in your move in the format 'A1-A5'.

The cartridge is accompanied by an eight-page booklet which contains a 'Teach yourself chess' section. However, this section leaves much to be desired if you are a novice at chess.

Summary

All-in-all, Sargon II is one of Commodore's best cartridges yet. I would recommend it to anybody who likes a good game of chess. Even if it is £5 more than any other cartridge, it is definitely worth it. **TR**

Space Intruders

Quicksilver, 92 Northam Road, Southampton.
ZX Spectrum, 16K, cassette.
Price: £5.95.

There is very little games software for the ZX Spectrum as yet. Of that which I have seen, this is the best. At almost £6, though, it seems a little expensive.

As the name suggests, this is a space invaders type of game. If you do not like these games do not bother reading further. *Space Intruders* is written in machine code, is fast, has good graphics, reasonable (if quiet) sound effects, and is a fairly simple version of the game.

It is fun to play, with the intruders appearing neither too fast nor too slow at the beginning, and then speeding up when only a few intruders are left. They approach the base with steadily increasing pace, and quite often crash into the base to end the game. Scores are high, once up

to 350,000, but I never managed to get beyond seven attack waves.

Apart from the game itself there were several nice touches. The best was the Hold facility, which meant that when I had to answer the door, the game was stopped exactly where it was. I could talk for hours and then carry on with the game from where I had left off by pressing Start. Sometimes, if I had managed to get as far as the third wave of intruders (not a common happening), pressing H allowed a quick breather before re-entering the battle.

Another good feature is the way in which the initials of the person with the highest score are entered.

Summary

A good example of this genre, with some useful features, and a slight touch of humour. After the first wave has been vanquished, each successive wave has a wobbly mutant intruder (for which you get more points) which, until it reverts to normality, looks quite funny wobbling across the screen. **BA**

Tasword

Tasman Software, 17 Hartley Crescent, Leeds LS2 2LL.
ZX81, 16K, cassette.
Price: £8.50.

Tasword is a new word-processing program from Tasman Software. This company also publishes a couple of very impressive educational programs, which will be evaluated in a forthcoming look at available Sinclair educational software.

Impressive is the only word, too, for the book of documentation that comes with Tasword. It is well written and has been printed with the aid of Tasword itself.

Side II presents a tutorial program. It is an eloquent demonstration of Tasword's uses, and a great help in exploring the main program's complexities.

Having practiced the commands available, the user can load Side 1, upon completion of which he is presented with a blank page. At the bottom is the line number, which at the start is set at 1. A flashing cursor is at the top left awaiting your first input.

One of the most useful features of Tasword is the full left and right justification. This is done automatically as you type, so that the keyboard can be given full attention.

The 'Word-Wrap' facility means that any word that over-runs the end of the line is moved down to the next line. Thus, the Newline key is only needed to start a new paragraph. The 'Word-Wrap' is normally on, but it can be keyed off in order to split a

word between two lines.

This facility, together with the automatic justification means that the user would not normally have to look at the screen until the end of each typing session.

The cursor can be moved to any position on the screen, in order to edit text. Adding or altering words or symbols destroys the justification, but the program will, upon command, re-justify the whole paragraph. It's almost worth the price to watch it do this.

There are several other commands available while typing in text. Whole lines may be moved left and right, headings centred, and so on.

Once the text is complete, it can be read by scrolling up or down. Also, the start or finish may be immediately found.

The program allows 320 lines, or 14 screens of text. This number can be reduced (before typing starts), thus cutting down on subsequent Saving and Loading time.

Tasword contains a Help page which can be referred to at any time. It lists the functions of all the command keys (Edit, Scroll, Insert-characters, etc).

Summary

Tasword is obviously not going to be any sort of competition for Word Star and the like. It does not contain a dictionary against which it can check spellings and it does not have any kind of tabulation. But neither does it need several thousand pounds worth of hardware to run it.

The program is very good value and great fun to use. Tasword will be a boon to anyone who has to prepare articles, or notices for their club, and so on. Unreservedly recommended. **TB**

HOW TASWORD WORKS

THE TEXT FILE

TASWORD OPERATES ON A TEXT FILE WHICH IS 320 LINES LONG. THIS TEXT FILE CONTAINS WHATEVER YOU TYPE. AT THE END OF THE RECORD, (THE SIZE OF THE TEXT FILE CAN BE CHANGED - SEE PAGE 10) YOU CAN DIVIDE IT INTO 14 SCREENS SHOWING 32 LINES OF THE TEXT FILE. THE CURSOR CONTROL KEYS MOVE THE CURSOR UP OR DOWN THE TEXT FILE.

THE REVERSE

EACH TIME YOU PRESS A SINGLE KEY, THE CHARACTER ON THAT KEY APPEARS ON THE SCREEN. AT THE CURSOR POSITION, THE NEXT KEY IS THE NEXT LINE. THE SPACE KEY LIFTS THE CURSOR TO THE BEGINNING OF THE NEXT LINE.

CERTAIN CHARACTERS ARE MARKED IN RED ON THE REVERSE. TO TYPE ONE OF THESE CHARACTERS HOLD THE RED KEY DOWN WHILE YOU PRESS THE DESIRED KEY. (E.g. * * * * *)

THE RED MARKINGS ON SOME OF THE CHARACTERS ARE NOT SINGLE CHARACTERS BUT ARE WORDS OR DOUBLE CHARACTERS. (E.G. * * * * * ETC.) THESE ARE THE TASWORD CONTROL KEYS.

Preview

Hollywood gets inside the video game

Brendon Gore looks behind the scenes of an exciting new film.

Tron is a Walt Disney film that follows in the trail of other science fiction speculaculars such as *Star Wars*, *Close Encounters Of The Third Kind* and *Battlestar Galactica*. It has opened to considerable acclaim in the US and is due to be released in the UK in October.

Set in the not too distant future Tron starts out as a conventional thriller. Kevin Flynn, played by Jeff Bridges, is attempting to gain access to information stored in computer data banks at Encom, a multinational communications company.

Flynn is trying to prove that he wrote a number of highly successful video arcade games while he was employed by Encom. Another Encom employee, Ed Dillinger, took the credit for inventing the games. Dillinger was subsequently promoted to company vice-president.

With the help of a fake access code, Flynn searches the Encom computer for evidence to back up his claims. But the computer's Master Control Program (MCP) is aware of Flynn's activities and cuts off his input. When Flynn tries to deprogram the MCP, it activates an experimental laser and turns it on him.

This is where the film really takes off. The laser is a form of matter transmitter which can break down objects into electrical particles and reconstitute them elsewhere.

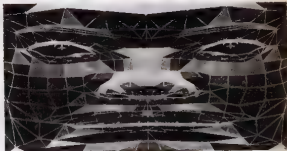
Flynn is translated into another dimension, an electronic world where computer programs have come to life. Flynn has become, literally, the player in the machine.

This world is ruled by the tyrannical MCP and by Sark, Dillinger's alter ego. Programs who disagree with the MCP are captured and released in the video games grid, an arena where video games are fought to the death.

The main opposition to the MCP is provided by Tron, a video games warrior played by Bruce Boxleitner. Tron is one of the few programs who still believes in the Users, the real world programmers who created them.

Tron and Flynn are matched together in the video games grid. But, using hi-res light-cycles, they manage to escape.

With Sark and the MCP's minions in hot pursuit, Tron and Flynn find two allies in



The Master Control Program (MCP) is the computer overlord in the new film *Tron*.

Yori and Bit. Bit is an electrical pulse who can only answer yes or no, depending on whether his charge is positive or negative.

Together, they link up with an old priest, Dumont, who plays a similar role to Obi-wan Kenobi in *Star Wars*. Dumont gives Tron an identity disc which can store information or be used as a weapon. Thrown like a frisbee, the disc heats up and cuts through its victim.

Armed with the disc, Tron confronts Sark in a program-to-program duel to the death. Sark loses the duel with Tron, but is revived by the MCP. But, just when it seems that Sark may be indestructible, Flynn destroys the MCP's power source.

As the MCP disintegrates, Flynn finds himself back in the real world. With access to the Encom computer, Flynn can prove his case.

Tron should be a fascinating film that will owe much of its success to the imaginative use of computer graphics. Director Stephen Lisberger, a long time fan of video games, first had the idea for the film in 1978.

"We had played all the video games," says Lisberger. "And when we investigated computer art, we realised that by combining the concepts of electronic imaging we could bring something to life that

had not been there before.

"Everyone's looking for new fantasies in the movies," he says. "Outer space has been done to death. They have gone inside the body and under the sea."

"We have created this world in *Tron* by taking video games and just blowing them out to the point where they are a reality. At the point where the games met computer graphics, something came alive that had not been alive before. Video games were the basis for the fantasy — computer imagery was the means to create it."

The computer graphics used in the film were largely created by two US companies, Information International Inc (Triple-I) and Mathematical Applications Group Inc (MAGI).

Artists' impressions of various objects in the film, such as the hi-res light-cycles, were plotted in three dimensions and fed into a digital computer. This enabled the object's movement to be choreographed frame by frame through the film.

Each frame on the film contained two million pixels, and each pixel was assigned both colour and intensity values. Thus, the 24 frames which make up one second of the film contained almost 100 million bits of information.

"For objects simulated in a computer there are no laws of physics," says Richard Taylor of Triple-I. "Each time you sit down to create a computer image, you are setting completely new rules for reality. That's what *Tron* is all about."

"Tron is likely to give rise to a number of spin-offs. Bally Manufacturing, the largest producer of video arcade games in the US, is currently working on a Tron video game. It will be available in the UK later this year or early next year.

Given the success of sequels such as *Rocky II* and *III* and *The Empire Strikes Back*, there is a fair chance that *Tron II* will appear on the cinema screen before too long.



Human lights video warriors in *Tron*.



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Each week the editor goes through all the programs that you send to Open Forum in order to find the Program of the Week.

The author of that program will qualify for DOUBLE the usual fee we pay for published programs.

(The usual fee is £10.)

Presentation hints

Programs which are most likely to be considered for the Program of the Week will be computer printed and accompanied by a cassette.

The program will be well documented, the documentation being typed with a double spacing between each line. The documentation should start with a general description of the program and then give some detail of how the program has been constructed and of its special features.

Listings taken from a ZX Printer should be cut into convenient lengths and carefully stuck down on to white paper, avoiding any creasing.

Please enclose a stamped, self-addressed envelope.

Reaction Timer

on Spectrum

Enter the program as listed and Run. The instructions are displayed and you should press any key to proceed.

When you have pressed a key there will be a random delay in which if you press a key a message saying 'do not cheat' will be displayed and you will be asked to press another key to proceed.

When the border colour changes you should press any key as fast as you can and your reaction time will be displayed. If you took longer than .5 seconds then a message 'do not waste my time' will appear, and you will again be asked to press any key to proceed.

If your reaction was not the fastest then the fastest will be displayed with the name of the person who achieved this.

If your reaction was the fastest you are told so and you can enter in your name. When you have done so it will be displayed and you will be asked as to whether you want another go.

Reaction Timer

by Christopher Green

```
20 RANDOMIZE : LET a$="Christo
pher Green": LET a=.2: PAPER 0:
INK 7: BORDER 0: CLS
30 GO SUB 100: PRINT AT 5,0;"T
his program tests your reaction"
;TAB 14;"time.";AT 9,1;"When the
border colour changes press any
key as fast as you can your reac
tion time will then be";TAB 14;"
given.";AT 10,3; FLASH 1;" Press
any key to proceed ": PAUSE 6E+
4: CLS
40 PAUSE RND*150+100: IF CODE
INKEY$=0 THEN GO TO 60
50 PRINT PAPER 6; INK 9;AT 20,
10;"Do not cheat": GO TO 30
60 POKE 23672,0: POKE 23673,0:
BORDER 6: PAUSE 55: LET time=(P
EEK 23672-1)/50
70 IF time>.5 THEN PRINT PAPER
6; INK 2;AT 20,6;"Do not waste
my time": GO TO 30
80 GO SUB 100: PRINT INK 7;AT
5,6;"Your reaction time was";TAB
10;time;" Seconds": IF time=0
THEN GO TO 110
90 LET a=time: INPUT INK 4; FL
ASH 1;" Please enter your name "
; a$
100 IF a$="" OR LEN a$>31 THEN
GO TO 30
110 PRINT AT 9,4; INK 4;"The fa
stest reaction was";TAB 10;a;" Se
conds";TAB 6;"and was achieved
by";TAB INT ((16-LEN a$)/2);a$;AT
17,2; FLASH 1; INK 9; PAPER 6;"
Do you require another go? ": PR
INT TAB 6; PAPER 6; INK 9; FLASH
1;" Press Y or N ": PAUSE 6E+4
120 LET b$=INKEY$: IF b$<>"Y" A
ND b$<>"n" AND b$<>"N" AND b$<>"
Y" THEN GO TO 110
140 CLS : IF b$="y" OR b$="Y" T
HEN GO TO 30
150 BORDER 2: PAPER 1: INK 9: C
LS : PRINT AT 10,6;" End of prog
ram ": GO TO 999
160 BORDER 0: PRINT AT 0,9;"REA
CTION TIMER": PLOT 71,167: DRAW
114,0: PLOT 72,166: DRAW 112,0:
RETURN
```

Open Forum

Super Nova

on Vic 20

This is a space game for the Vic20. It uses user-defined graphics, so it will only run on the basic machine.

The idea is simple. You must avoid the randomly generated asteroids, and missiles, and try and run into the two different types of alien. You have three lives which can be used up by the asteroids and missiles. The game ends either when you

have lost all three lives or when you run out of fuel — in which case you win.

The spaceship is made up out of four squares and is user-defined. The aliens are also user-defined, as are the asteroids and missiles. The program takes full advantage of the Vic's sound, colour and graphics capabilities.

Lines 1 to 8 set up the title and colour
Lines 19 to 98 set up the screen and the variables
Lines 99 to 100 decide which keys move the spaceship
Lines 105 to 108 find out if you have hit anything
Line 109 decides if you have run out of fuel
Lines 104 to 200 output an explosion and deduct a life

Lines 300-400 print the score and end the game
Lines 500 to 594 make sounds to tell you that you are out of fuel

Lines 700 to 740 print the first sort of spaceship
Lines 900 to 930 tell you if you have hit the first sort of spaceship

Lines 1500 to 1540 print the second spaceship
Lines 1700 to 1730 tell you if you have hit the second spaceship

Lines 1740 to 1760 print missiles
Lines 2000 onwards are data for graphics

There will be a short pause when you run the game while the graphics are set up. Control is achieved through the two cursor keys.

Super Nova
by Neil Sibley

```

1 PRINT "SUPER NOVA":REM BY NEIL SIBLEY (C)1982
2 PRINT "HIT A KEY TO START"
3 GET0$:IF0$="":THEN3
5 FORH=1 TO 100:NEXTH:GOSUB2000
6 POKE36879,0:POKE36869,255
7 H=0:S=0:Z=0:T=0
8 Q=50
10 A=7990:R=1:D=8164
20 FORJ=1 TO 24:POKE199,0:PRINT:NEXTJ
25 FORK=1 TO 7000
30 POKE0+INT(25*AND(1)),2
31 POKE36879,6:POKE36877,130
35 R=INT(25*AND(1))
36 IFR=1 THEN 700
37 IFR=2 THEN 500
38 IFR=3 THEN 1740
40 FORJ=1 TO 0:NEXTJ
45 Q=Q-5:125
50 POKEA+0,32:POKEA+B+22,32:POKEA+B+44,32:POKEA+B+66,32
55 PRINT:GOTO60
56 PRINT:PRINT
60 GET0$
70 IFR$="" THEN 100
80 IFR$1 AND 0$="" THEN B=B+1:POKE36877,128:POKE36878,15:FORJ=1 TO 10:EXTJ:POKE7910+
A+B,32
90 IFR$21 AND 0$="" THEN B=B+1:POKE36877,128:POKE36878,15:FORJ=1 TO 10:EXTJ
100 POKEA+B,0:POKEA+B+22,1:POKEA+B+44,5:POKEA+B+66,7
105 IFPEEK((A+B+66+22))=2 THEN T=T+1:GOTO114
106 IFPEEK((A+B+66+22))=3 THEN 3000
107 IFPEEK((A+B+66+22))=8 THEN 1600
108 IFPEEK((A+B+66+22))=9 THEN T=T+1:GOTO114
110 IFK=>660 THEN 500
112 EXTJ
114 POKE36879,42
115 FORA=0,4:POKEA+B+22,5:POKEA+B+44,7:POKEA+B+66,5
200 POKE36877,220
210 FORL=1 TO 8 STEP-1
220 POKE36878,L
230 FORM=1 TO 100
240 NEXTM
250 NEXTL
260 POKE36877,160
270 POKE36879,0
275 POKE36879,9

```

Open Forum

```

277 PRINT "DO YOU HAVE '3+T'; 'LIVE; LEFT'; 'FORS=1T01000; NEXTS
278 POKE36869,255
279 IFT=-3THEN313
280 GOTO300
300 PRINT "WELL DONE YOU MANAGED TO LAST OUT"
301 PRINT "UNTIL YOUR FUEL RAN"
302 PRINT "OUT." : FORS=1T02500 : NEXTS
313 Z=X : POKE36869,240
315 PRINT "YOU SCORED",Z : IFT=-3THENPRINT "BEFORE YOU GOT BLOWN" : PRINT "UP"
336 PRINT
337 PRINT
338 PRINT
339 PRINT
340 PRINT
400 END
500 L=1 : POKE36878,15
501 POKE36877,0 : FORS=128T0240 : POKE36875,3 : NEXTS : POKE36877,240 : FORS=1T0200 : NEXTS
502 POKE36875,0 : POKE36875,240 : FORS=1T0200 : NEXTS : L=L+1
503 IFL<4THEN501
504 GOTO500
600 T=-1 : GOTO14
700 FORP=1T010
710 POKED=INT(32*RND(1)),3
720 FORJ=1T00 : NEXTJ
730 POKER=P,32 : POKER+P+22,32 : POKER+P+44,32 : POKER+P+66,32
740 GOTO55
800 POKE36879,127
900 POKE36877,0
930 POKE36878,11
950 FORS=250T0160STEP-0.5 : POKE36876,S : NEXTS
970 POKE36876,0
1000 POKE36878,0
1001 POKE36869,255
1010 X=X+INT(500*RND(100))+100
1011 PRINT "*****" : X : FORS=1T01000 : NEXTS : POKE36869,255
1020 POKE36879,0
1030 GOTO300
1242 FORJ=1T00 : NEXTJ
1500 FORP=1T010
1510 POKED=INT(32*RND(1)),8
1520 FORJ=1T00 : NEXTJ
1530 POKER=P,32 : POKER+P+22,32 : POKER+P+44,32 : POKER+P+66,32
1540 GOTO55
1600 POKE36879,110
1620 POKE36877,0
1630 POKE36878,15
1650 FORS=160T0250STEP0.5 : POKE36876,S : NEXTS
1670 POKE36876,0
1700 POKE36878,0
1701 POKE36869,255
1710 X=X+INT(7500*RND(100))+100
1711 PRINT "*****" : X : FORS=1T01000 : NEXTS : POKE36869,255
1720 POKE36879,0
1730 GOTO300

```

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Open Forum

Dodge

on BBC Micro

This game is based on a program written for a Vic20 by Stuart Debus of Bognor Regis. I have modified it considerably in order to run it on a BBC Model A computer, and it now bears little resemblance to his program.

It is all in Teletext mode, as this allows the Model A to use more than four colours.

The object of the game is to survive, by dodging the asteroids (asterisks), for as long as possible whilst hitting as many aliens (asterisks) as one can.

The actual game is called by line 260.

Lines 470-540 initialise the variables. B% holds the current position of your ship, represented by a magenta V. Line 490 turns off the auto-repeat. Line 510 sets up a text window the size of the whole screen. If this was omitted, the scrolling would not work as we want it to.

The game, proper, is in lines 550-740. Lines 560-590 prints between 1 and 6 asterisks onto the screen. There is a 1 in 10 chance of an alien being printed on each row; lines 600-610. The game finishes when you have hit 12 asteroids, and the duration of the game is recorded, lines 740-750.

Lines 850-960 define the procedure to handle collision with an asteroid, whilst

lines 1000-1150 deal with the collision with an alien. Lines 1170-1240 provide a sonic departure from the game. I have called it PROCclung as an incentive to modification.

After PROCplay, the screen is cleared and the highest score so far is calculated, lines 270-290. Lines 310-360 provide a report. Lines 410-420 put the cursor keys back to normal. Lines 430-440 provide a test mode, à la The Computer Program.

As this is written in Mode 7, there is ample memory left (even on a Model A) for modifications. The main drawback, here, of using Teletext mode, is that we cannot define special characters; however, even as it stands, although basically simple, it is very addictive.

Dodge

by D. Lenthall

```

10 REM *****
20 REM **
30 REM **          U O D G E          **
40 REM **
50 REM **          By D. Lenthall.      **
60 REM **
70 REM *****
80 MODE 7
90 *FX 4,1
100 ENVELOPE 1,0, 3,5,-9,20,1,16, 126,-4,0, 1,126,98
110 VDU 22;8202;099;0;
120 PRINT TAB(12,3) CHR$(133);CHR$(136);CHR$(141);"D O D G E"
130 PRINT TAB(12) CHR$(133);CHR$(136);CHR$(141);"D O D G E"
140 PRINT TAB(12) CHR$(131);CHR$(136);STRING$(11,"_")
150 PROCwait(150)
160 PRINT TAB(2,9) CHR$(130);"Your mission is to destroy, by"
170 PRINT CHR$(130);"means as many aliens as possible."
180 PRINT CHR$(130);"Hitting asteroids uses up your shield"
190 PRINT CHR$(130);"energy, and this determines the length"
200 PRINT CHR$(130);"of the game."
210 PROCwait(200)
220 PRINT TAB(7,19) CHR$(129);"Use cursor keys";CHR$(134);CHR$(91);
CHR$(129);"and";CHR$(134);CHR$(93)
230 PRINT TAB(5) CHR$(129);"for left and right movement."
240 PRINT TAB(6,22) CHR$(132);CHR$(136);"Hit any key to continue."
250 hiscore=0:hitime=0:AH=GET$:VDU 7
260 PROCplay
270 CLS
280 IF aliens=hiscore THEN IF time>hitime THEN hitime=time:goto 300
290 IF aliens>hiscore THEN hiscore=aliens:hitime=time
300 IF aliens=1 THEN AL$="alien." ELSE AL$="aliens."
310 PRINT TAB(3,4) CHR$(130);"You survived for";CHR$(131);time;CHR$(
130);"seconds."
320 PRINT TAB(1,6) CHR$(130);"During this time, you hit";CHR$(131);
=aliens;CHR$(130);AL$
330 PRINT TAB(7,9) CHR$(129);"Current highest score:"
340 PRINT TAB(5,11) CHR$(134);hiscore;CHR$(129);"aliens in";
CHR$(134);hitime;CHR$(129);"seconds."
350 PRINT TAB(2,16) CHR$(133);"Do you wish to have another life?"

```


Spectrum

The case for a capital transfer code

Roger Valentine explains how to swap from upper to lower case and back again.

This machine code utility routine provides three extra toolkit functions for the ZX Spectrum. *Use 65270* reads through a Basic program, converting all lower case letters to upper case; *Use 65290* converts upper case to lower case; *Use 65200* gives the number of bytes used by the Basic program.

These addresses assume that the code is loaded at address 65200 on a 48K Spectrum. The minor changes necessary to relocate for 16K are given at the end of this article.

The program length section is a useful facility in its own right, both for checking total program length and for testing the relative lengths of alternative lines.

The routine is written in three separate modules. The program length module merely subtracts the system variable *Prog* from the system variable *Vars*. The difference, i.e. length of the program, is given in *bc*. If that is all you want, you can omit *Push bc* and *Pop hl*, which puts *Prog* into *hl* for use in module two.

The Basic program doubles as a loader and a demonstration of the case swap routine. Line 10 reserves ample memory by lowering *Ramtop*.

When you *Run* the program, the *Stop* statement in line 90 will be encountered as soon as the machine code has been loaded. At this point, enter *Conf* to list in upper case, *Conf* again to list in lower case, and *Conf* a third time to print the program length.

Line 9000 *Saves the Loader* program, which is definitely to be recommended before *Running*. Once the routine is working correctly, you can enter *New* and save the routine without the loader:

SAVE CASE SWAP CODE 65299, 194

16K conversion

The routine can be relocated in a 16K Spectrum with the minimum of difficulty. The only bytes which must be altered are where module three *Calls* module two and module two *Calls* module one.

These bytes have been underlined in the listing. The routine occupies 104 bytes, so a suitable location in 16K would be 32000 (CLEAR 31999).

Addr	Assembly	Hex	Decimal	Effect
Module 1				
65000	XDR A	AF	175	Clear carry
	LD HL, (VARS)	2A 4B 5C	42 75 92	HL ← VARS
	LD SC, (PROG)	ED 4B 5D 5C	237 75 93 92	SC ← PROG
	PUSH BC	CA	187	
	SBC HL, SC	ED 42	237 65	HL ← (VARS) - (PROG)
	PUSH HL	E5	228	
	POP BC	C1	153	BC ← (VARS) - (PROG)
	POP HL	E1	229	HL ← (PROG)
	RET	C6	261	
Module 2				
65216	CALL 65266	CD <u>86</u> <u>FE</u>	<u>265</u> <u>176</u> <u>264</u>	Call module 1
	DEC BC	86	11	
	LD A, B	78	120	
	AND A	A7	187	
	CP 9	FE 90	254 0	Test if BC < 9
	JR NZ B	59 25	32 5	(in program completed)
	LD A, C	79	121	
	AND A	A7	187	
	CP 9	FE 90	254 0	
	RET Z	C6	260	
	INC HL	E3	23	Stop 5 bytes
	DEC BC	86	11	for 'enter' and
	INC HL	E3	23	line number
	DEC BC	86	11	
	INC HL	E3	23	
	LD A, (HL)	7E	126	
	CP 13	FE 03	254 13	Is it 'enter'?
	JR Z 228	25 04	48 228	Y-Stop 5 bytes
	CP 14	FE 0C	254 14	Is it a number?
	JR NZ 24	59 04	32 4	No
	DEC BC	86	11	Y-Stop 5 bytes
	INC HL	E3	23	
	JR 222	18 06	24 222	
	AND A	A7	187	
65263	SUB 97	D6 81	214 87	Is it >="A"? 7
	JR C 8	38 98	56 8	No, next byte
	AND A	A7	187	
	SUB 28	D6 1A	214 28	Is it <="Z"? 7
	JR NC 5	38 03	48 3	No
65262	ADD 91	66 90	186 91	Yes, Change to
	LD (HL), A	77 17	116	capital
	DEC BC	86	11	Next byte
	INC HL	E3	23	
	JR 228	18 06	24 228	
Module 3				
65269	HOP	96	0	
65270	LD A, 97	3C 61	62 97	Lower
	LD (RAM), A	32 <u>61</u> <u>FE</u>	<u>58</u> <u>226</u> <u>264</u>	case
	LD A, 91	3C 5F	62 91	to
	LD (RAM), A	32 <u>5F</u> <u>FE</u>	<u>58</u> <u>225</u> <u>264</u>	upper
	LD (RAM), A	CD <u>5F</u> <u>FE</u>	<u>298</u> <u>175</u> <u>264</u>	case
	RET	C6	261	
	HOP	96	0	
	HOP	96	0	
	HOP	96	0	
	HOP	96	0	
	HOP	96	0	
	HOP	96	0	
65280	LD A, 85	3C 41	62 85	Upper
	LD (RAM), A	32 <u>41</u> <u>FE</u>	<u>58</u> <u>226</u> <u>264</u>	case
	LD A, 123	3C 7B	62 123	to
	LD (RAM), A	32 <u>7B</u> <u>FE</u>	<u>58</u> <u>225</u> <u>264</u>	lower
	LD (RAM), A	CD <u>7B</u> <u>FE</u>	<u>297</u> <u>175</u> <u>264</u>	case
65283	RET	C6	261	
Basic LOADER				
10	CLEAR 60-99		115	RANDOMIZE USER upper to lower, LIST: STOP
20	LET mem=65299		112	CLEAR PRINT USER mem used: STOP
30	RESTORE LET a=8		200	DATA 175, 62, 176, 237, 75, 92, 97, 237, 86,
40	READ a			229, 187, 225, 281
50	IF a=9999 THEN GOTO 90		300	DATA 285, 176, 254, 11, 126, 187, 254, 8, 32, 5, 121, 187,
60	FOR mem=a TO 99			284, 284, 35, 11, 35, 11, 35, 11, 35, 11, 35, 11,
70	LET s=s+1			254, 13, 49, 239, 254, 14, 20, 4, 11, 35, 24, 225, 187,
80	GOTO 40			214, 87, 56, 8, 187, 214, 25, 48, 3, 186, 91, 119, 11,
90	STOP			38, 24, 226
100	LET lower to upper=65270		400	DATA 9, 62, 97, 58, 236, 254, 82, 88, 58, 236, 284, 205,
110	LET upper to lower=65280			181, 254, 281, 5, 8, 8, 8, 8, 82, 85, 58, 236, 284, 83,
120	LET mem used=65269			129, 58, 226, 254, 285, 151, 254, 264
130	RANDOMIZE USER lower to upper, LIST: STOP		9000	SAVE "loader" LINE 9
			9999	DATA 9999

Sound & vision



Building tunes note by note

This program was written for the BBC micro, models A and B, and is only really suitable for those familiar with music.

The program only produces one note at a time, since more notes would require too many inputs. So, you can only type in the main tune.

Take hold of a music manuscript of your favourite tune, sit down at your computer and start to type in the data. The program will ask you for the speed of the piece. You will get some idea of this from the Italian expression which should appear above the piece. Do not worry if the speed is wrong — it can be changed later.

You are then asked for the pitch. There is a table on the right-hand side of the screen with the values of the notes of the scale. The number 53 is middle C and the next number to the right is the C one octave above that.

Next, you are asked for the length. This simply means the duration of the note. The note's length is taken relative to one crotchet, as is normally done in music. This value is one, so if you are typing in a note which is a quaver, your value for length will be 0.5. The lengths of other notes are given below:

Semibreve	4
Minim	2
Crotchet	1
Quaver	0.5
Sixteenth	0.25
Demisixteenth	0.125

If you need to put a rest in your piece, type 0 on answer to pitch.

You repeat this process until you have finished your tune. Now, type 300 on answer to pitch and the tune will play.

After the tune has been played, you will be given a list of options: You can hear the tune again; type in a different tune; save your tune on tape; or load another tune from tape.

The last option can be put to good use. Several tunes can be placed on tape and played one after another. Press key L as many times as there are tunes on the cassette. This will store them in a stack and the program will progressively play all the tunes you have on tape. **Peter Donn**

```

10 MODE:VDU19,0,4,0,0
20 VDU19,1,3,0,0
30 A=0
40 DIM A(2,255)
50 PRINT "You are going to compose a piece of music step by
step, on answer to two questions - LENGTH and PITCH"
60 PRINT "LENGTH is kind of note e.g. a crotchet is 1, a quaver is
0.5"
70 PRINT "When asked PITCH type in relevant number from table on
right"
80 PRINT "When you have finished your tune type 300 on
answer to PITCH and your tune can be played"
90 PRINT "If you should want to put a rest in the tune type 0 in
answer to PITCH"
100 PRINT "How fast is the piece - give a value", "between 1 and
20 (1 is fast)" INPUT E
110 CLS:PRINT "TAB(15), "octave"
120 PRINT TAB(10), "1 2 3 4 5 6 7"
130 PRINT TAB(10), "B 1 48 97 145 193 241"
140 PRINT TAB(10), "A# 45 93 141 189 237"
150 PRINT TAB(10), "A 41 89 137 185 233"
160 PRINT TAB(10), "G# 37 85 133 181 229"
170 PRINT TAB(10), "G 33 81 129 177 225"
180 PRINT TAB(10), "F# 29 77 125 173 221"
190 PRINT TAB(10), "F 25 73 121 169 217"
200 PRINT TAB(10), "E 21 69 117 165 213"
210 PRINT TAB(10), "D# 17 65 113 161 209"
220 PRINT TAB(10), "D 13 61 109 157 205 253"
230 PRINT TAB(10), "C# 9 57 105 153 201 249"
240 PRINT TAB(10), "C 5 53 101 149 197 245"
250 PRINT "STARTING" P
260 A=A+1
270 VDU11:VDU11
280 PRINT "PITCH"
290 INPUT D:IF D=300 THEN 350
300 A(1,A)=D
310 VDU11:VDU11
320 PRINT "LENGTH"
330 INPUT C:A(2,A)=C
340 GOTO 290
350 FOR B=0 TO A
360 IF A(1,B)=0 SOUND1 G(A(1,B),A(2,B)):E:GOTO 360
370 SOUND1, -15,A(1,B),A(2,B):E
380 NEXT
390 PRINT "PRESS A TO HEAR THAT AGAIN" P TO PLAY
ANOTHER TUNE" R TO RECORD THE TUNE ON
TAPE" "OR L TO LOAD A TUNE FROM TAPE"
400 AS=GET$
410 IF AS="A" INPUT "SPEED(1 TO 20):" E:GOTO 350
420 IF AS="R" THEN RUN
430 IF AS="L" THEN 460
440 IF AS="T" THEN 540
450 PRINT "ONE OF THOSE COMMANDS PLEASE" GOTO 400
460 PRINT X=OPENOUT("TUNE")
470 FOR B=0 TO A
480 BPUT#X,A(1,B):BPUT#X,A(2,B):60
490 FOR Z=0 TO 59-NEXT
500 NEXT
510 CLOSE#X
520 PRINT TAB(8), "RECORDED"
530 GOTO 390
540 X=OPENIN("TUNE")
550 B=0 REPEAT B=B+1
560 A(1,B)=BGET#(X):A(2,B)=BGET#(X):60
570 UNTIL EOF#X
580 CLOSE#X
590 A=B
600 PRINT "TAB(8), "READY" GOTO 350

```

Peek & poke

Peek your problems to our address. Ian Beardsmore will poke back an answer.

THE CURSOR OF FRANKENSTEIN?

James Ansell of Beechwood Avenue, Darlington, writes:

Q Please could you explain why my Sinclair crashes so often. Sometimes the cursor sticks and will not move, or the screen fills up with graphic characters.

Could you explain what you use the Step function for? Also, could you explain what the function Φ is used for on a computer like the Triton, and what the Hash mark is used for? What does Vdu mean on the BBC micro and are there any functions to do the same on the ZX81. Finally, what are the Poke numbers for Foking numbers on to the screen of the ZX81.

A It sounds as though your Ram is decaying. Do you have a Ram pack fitted? If so, this is the most likely cause.

Unfortunately, if your Ram pack is the trouble then it will have to be exchanged. If you do not have a Ram pack then it is the onboard Ram, or even the Rom that is at fault which means getting back to Sinclair.

The Step function can assign you numbers in a progression other than that of plus one. These Steps can be used in a variety of ways. For example:

```
10 FOR A = 1 TO 66 STEP 3
20 PRINT A
30 NEXT A
```

or else they can be used backwards, and with longer numbers. Try replacing line 10 with:

```
10 FOR A = 1953 TO 9 STEP -47
```

I used the Step function in PCW June 17 to help set up a histogram graph. A simple guessing game can be built around a Step function.

```
10 LET A = 0
20 LET C = INT(RND*20) + 1
30 INPUT B
40 FOR D = 1 TO 20 STEP B
50 LET A = A + 1
60 IF A >= 10 THEN GOTO 180
70 IF D = C THEN GOTO 120
80 IF D > C THEN GOTO 180
90 NEXT B
100 PRINT "YOU HAVE RUN OUT OF TURNS"
110 STOP
120 PRINT "YOU HAVE GUESSED MY NUMBER IN A STEPS"
130 STOP
```

The computer guesses a

number, C, and you have to guess what it is. If you put a high number in for the Step function, then it will only look at a few numbers between one and 20. But, if it gets the right one it will only take a few Steps. If on the other hand you input a low number, then you are more likely to get it. A one will always get the number if it is lower than 15. If you go above 20 and still have some Steps left then you will find 30 to choose a new Step number.

The function Φ on other computers, is Print at on a ZX81. The hash symbol is used when addressing a disc operating system or disc drive. For example, on a BBC computer Cline n would close off file number n.

Vdu is used when addressing the screen on a BBC micro. You cannot Poke into the memory locations of a screen on a ZX81 because the ZX81 is not memory mapped.

I'VE BEEN THROWN A WOBLER!

G R Baicombe of 77 Green-side, Buxton, Cheshire, Lancashire, writes:

Q I own a Commodore Vic20 with 5K Ram. Recently I purchased a JK expansion board, so now I have a lot more bytes to play with.

Unfortunately, when I started to type in an RK program, the cursor disappeared. Please can you tell me why?

A This sounds horribly like the dreaded Ram wobble that has so bedevilled ZX owners. Unfortunately, you do not say whether you can get the cursor back, or if you have had any problems without the extra Ram being fitted. I know from working with my Vic that even the slightest knock can sometimes make the program crash.

Have a close look at the edge connector on both the Ram pack and your computer. If they are dirty, clean them lightly with methylated spirits.

If the rest of the screen is maintained when the cursor disappears, try placing a small bit of card under the pack to support it. The fault may be

only a very small misalignment somewhere.

If the entire screen crashes, the fault is probably a more major mis-alignment. Try the pack in slightly different positions, ie loose, pushed up tight and so on. Do not forget to turn off the computer each time you change the Ram pack's position. If this fails, take it back to the shop you bought it from, tell them what the problem is and ask for a replacement.

FACING UP TO THE FACTS

Richard Beckett of the Department of Botany, Bristol University, writes:

Q I would like to interface various pieces of laboratory equipment to my ZX81 (and Spectrum when it arrives), and have worked out that I need an analogue to digital converter board. However, I have no idea how to make this interface. I would be most grateful if you could recommend any bloke that can help me.

A The book you want is 20 Simple Electronic Projects For The ZX81 by Stephen Adams. On page 53 it describes how to make an analogue to digital converter. The book is published by 'Interface', 44-46 Fairs Court Road, London W8 6LZ, and costs £6.45. We reviewed the book in our June issue.

IS THIS ALL THE LEVEL?

P Hampson of Rockend Drive, Cheddleton, Leek, Staffordshire, writes:

Q I have had a Vic-20 for some months now and am delighted with it. However, I am doing a computing 'O' level. As part of the course, I have to write a program and document it. But, I do not have enough money to buy a Vic printer.

Can a Vic printer be rented? Is it worth getting an Interface to connect my Vic to a ZX printer? If I got the printer, could I do Vic graphics on it?

One last question, what are the Vic books on Basic like,

and are they worth buying?

A It strikes me as odd that you need to have a printer. I am sure that most schools realise that this sort of expense cannot be borne by many pupils. Do they actually demand a printout or is it just that a printout will save you having to write or type out your program? Or, do you work on another computer at school, which does have a printer, but would prefer to do your work on a Vic20 because you have one at home?

I certainly think that you should ask your teacher if he or she can help. If they cannot supply a printer, then they should accept a typed copy.

If you are determined to get a proper printout, then I suggest you approach your nearest Vic dealer. If you explain the situation to him, and provide a cassette, he might run off a few copies for you.

I do not know of anyone that rents out printers. Perhaps your best bet would be a local computer club or branch of ICLPUK (Independent Commodore Products Users Group). Try asking in your local library if there are any such clubs or groups in your area.

Only you can decide if the ZX printer will be worth buying. It will cost in the region of £90-£95. It will do Vic graphics, but if your main concern is just this 'O' level, then I would not buy it.

As for the 'Vic books' you mention, I assume that you mean the Teach Yourself Basic course. If you know nothing about computing then they are an easy glossy way to start. The more you know, the less use they are. If you are at the stage of having to write a program for an 'O' level, then you will probably find little in them which is of much use.

STOP agonising over that nagging problem. Write to Ian Beardsmore at Peek & poke for the answer. Letters should be as brief as possible and include full name and address. Write to Peek & poke, Popular Computing Weekly, Highbush Court, 19 Whitcomb Street, London WC2J 7HF.

New ZX81 Software from Sinclair.

A whole new range of software for the Sinclair ZX81 Personal Computer is now available - direct from Sinclair. Produced by ICL and Psion, these really excellent cassettes cover games, education, and business/household management.

Some of the more elaborate programs can only be run on a ZX81 augmented by the ZX16K RAM pack. (The description of each cassette makes it clear what hardware is required.) The RAM pack provides 16-times more memory in one complete module, and simply plugs into the rear of a ZX81. And the price has just been dramatically reduced to only £29.95.

The Sinclair ZX Printer offer full alphanumerics and highly-sophisticated graphics. A special feature is COPY which prints out exactly what is on the whole TV screen without the need for further instructions. So now you can print out your results for a permanent record. The ZX Printer plugs into the rear of your ZX81, and you can connect a RAM pack as well.

Games

Cassette G1: Super Programs 1 (ICL)

Hardware required - ZX81.
Price - £4.95.

Programs - Invasion from Jupiter, Skittles, Magic Square, Doodle, Kim, Liquid Capacity.
Description - Five games programs plus easy conversion between pints/gallons and litres.

Cassette G2: Super Programs 2 (ICL)

Hardware required - ZX81.
Price - £4.95.

Programs - Rings around Saturn, Secret Code, Mindboggling, Silhouette, Memory Test, Metric conversion.
Description - Five games plus easy conversion between inches/feet/yards and centimetres/metres.

Cassette G3: Super Programs 3 (ICL)

Hardware required - ZX81.
Price - £4.95.

Programs - Train Race, Challenge, Secret Message, Mind that Meteor, Character Doodle, Currency Conversion.
Description - Five games plus currency conversion at will - for example, dollars to pounds.

Cassette G4: Super Programs 4 (ICL)

Hardware required - ZX81.
Price - £4.95.

Programs - Down Under, Submarines, Doodling with Graphics, The Invisible Invader, Reaction, Petrol.
Description - Five games plus easy conversion between miles per gallon and European fuel consumption figures.

Cassette G5: Super Programs 5 (ICL)

Hardware required - ZX81 + 16K RAM.
Price - £4.95.

Programs - Martian Knock Out, Graffiti, Find the Mate, Labyrinth, Drop a Brick, Continental.

Description - Five games plus easy conversion between English and continental dress sizes.

Cassette G6: Super Programs 6 (ICL)

Hardware required - ZX81 + 16K RAM.
Price - £4.95.

Programs - Galactic Invasion, Journey into Danger, Create, Nine Hole Golf, Solitaire, Daylight Robbery.

Description - Six games making full use of the ZX81's moving graphics capability.

Cassette G7: Super Programs 7 (ICL)

Hardware required - ZX81.
Price - £4.95.

Programs - Racetrack, Chase, NIM, Tower of Hanoi, Docking the Spaceship, Golf.

Description - Six games including the fascinating Tower of Hanoi problem.

Cassette G8: Super Programs 8 (ICL)

Hardware required - ZX81 + 16K RAM.
Price - £4.95.

Programs - Star Trail (plus blank tape on side 2).
Description - Can you, as Captain Church of the UK spaceship Endeavour, rid the galaxy of the Klingon menace?

Cassette G9: Biorhythms (ICL)

Hardware required - ZX81 + 16K RAM.
Price - £6.95.

Programs - What are Biorhythms? Your Biorhythms.

Description - When will you be at your peak (and trough) physically, emotionally, and intellectually?

Cassette G10: Backgammon (Psion)

Hardware required - ZX81 + 16K RAM.
Price - £5.95.

Programs - Backgammon, Dice.
Description - A great program, using fast and efficient machine code, with graphics board, rolling dice, and doubling dice. The dice program can be used for any dice game.

Cassette G11: Chess (Psion)

Hardware required - ZX81 + 16K RAM.
Price - £6.95.

Programs - Chess, Chess Clock.
Description - Fast, efficient machine code, a graphic display of the board and pieces, plus six levels of ability, combine to make this one of the best chess programs available. The Chess Clock program can be used at any time.



Cassette G12: Fantasy Games (Psion)

Hardware required - ZX81 (or ZX80 with 8K BASIC ROM) + 16K RAM.
Price - £4.75.

Programs - Perilous Swamp, Sorcerer's Island.

Description - Perilous Swamp: rescue a beautiful princess from the evil wizard. Sorcerer's Island: you're marooned. To escape, you'll probably need the help of the Grand Sorcerer.

Cassette G13: Space Raiders and Bomber (Psion)

Hardware required - ZX81 + 16K RAM.
Price - £3.95.

Programs - Space Raiders, Bomber.
Description - Space Raiders is the ZX81 version of the popular pub game. Bomber: destroy a city before you hit a sky-scraper.

Cassette G14: Flight Simulation (Psion)

Hardware required - ZX81 + 16K RAM.
Price - £5.95.

Program - Flight Simulation (plus blank tape on side 2).

Description - Simulates a highly manoeuvrable light aircraft with full controls, instrumentation, a view through the cockpit window, and navigational aids. Happy landings!

Education

Cassette E1: Fun to Learn series - English Literature 1 (ICL)

Hardware required - ZX81 + 16K RAM.
Price - £6.95.

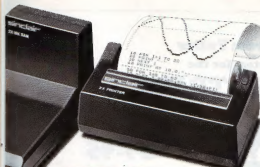
Programs - Novelists, Authors.
Description - Who wrote 'Robinson Crusoe'? Which novelist do you associate with Father Brown?

Cassette E2: Fun to Learn series - English Literature 2 (ICL)

Hardware required - ZX81 + 16K RAM.
Price - £6.95.

Programs - Poets, Playwrights, Modern Authors.

Description - Who wrote 'Song of the Shirt'? Which playwright also played cricket for England?



Cassette E3: Fun to Learn series - Geography 1 (ICL)

Hardware required - ZX81 + 16K RAM.

Price - £6.95.

Programs - Towns in England and Wales, Countries and Capitals of Europe. Description - The computer shows you a map and a list of towns. You locate the towns correctly. Or the computer challenges you to name a pinpointed location.

Cassette E4: Fun to Learn series - History 1 (ICL)

Hardware required - ZX81 + 16K RAM.

Price - £6.95.

Programs - Events in British History, British Monarchs. Description - From 1066 to 1981, find out when important events occurred. Recognise monarchs in an identity parade.

Cassette E5: Fun to Learn series - Mathematics 1 (ICL)

Hardware required - ZX81 + 16K RAM.

Price - £6.95.

Programs - Addition/Subtraction.

Multiplication/Division.

Description - Questions and answers on basic mathematics at different levels of difficulty.

Cassette E6: Fun to Learn series - Music 1 (ICL)

Hardware required - ZX81 + 16K RAM.

Price - £6.95.

Programs - Composers, Musicians.

Description - Which instrument does James Galway play? Who composed 'Peter Grimes'?

Cassette E7: Fun to Learn series - Inventions 1 (ICL)

Hardware required - ZX81 + 16K RAM.

Price - £6.95.

Programs - Inventions before 1850.

Inventions since 1850.

Description - Who invented television? What was the 'dangerous Lucifer'?

Cassette E8: Fun to Learn series - Spelling 1 (ICL)

Hardware required - ZX81 + 16K RAM.

Price - £6.95.

Programs - Series A1-A15, Series B1-B15.

Description - Listen to the word spoken on your tape recorder, then spell it out on your ZX81. 300 words in total suitable for 6-11 year olds.

Business/household

Cassette B1: The Collector's Pack (ICL)

Hardware required - ZX81 + 16K RAM.

Price - £9.95.

Program - Collector's Pack, plus blank tape or side 2 for program/data storage.

Description - This comprehensive program should allow collectors (of stamps, coins etc.) to hold up to 400 records of up to 6 different items on one cassette. Keep your records up to date and sorted into order.

Cassette B2: The Club Record Controller (ICL)

Hardware required - ZX81 + 16K RAM.

Price - £9.95.

Program - Club Record Controller plus blank tape on side 2 for program/data storage.

Description - Enables clubs to hold records of up to 100 members on one cassette. Allows for names, addresses, 'phone numbers plus five lots of additional information - eg type of membership.

Cassette B3: VU-CALC (Paion)

Hardware required - ZX81 + 16K RAM.

Price - £7.95.

Program - VU-CALC.

Description - Turns your ZX81 into an immensely powerful analysis chart. VU-CALC constructs, generates and calculates large tables for applications such as financial analysis, budget sheets, and projections. Complete with full instructions.

Cassette B4: VU-FILE (Paion)

Hardware required - ZX81 + 16K RAM.

Price - £7.95.

Programs - VU-FILE, Examples.

Description - A general-purpose information storage and retrieval program with emphasis on user-friendliness and visual display. Use it to catalogue your collection, maintain records or club memberships, keep track of your accounts, or as a telephone directory.

How to order

Simply use the FREEPOST order form below and either enclose a cheque or give us your credit card number. Credit card holders can order by phone - simply call Camberley (0276) 66104 or 21282 during office hours. Either way, please allow up to 28 days for delivery, and there's a 14-day money-back option, of course.

sinclair ZX81 SOFTWARE

Sinclair Research Ltd,

Slanhope Road, Camberley, Surrey,
GU15 3PS.

Tel: Camberley (0276) 66104 & 21282.

To: Sinclair Research, FREEPOST, Camberley, Surrey, GU15 3BR.
Please send me the items I have indicated below.

Qty	Cassette	Code	Item price	Total
	01: Super Programs 1	30	£4.95	
	02: Super Programs 2	31	£4.95	
	03: Super Programs 3	32	£4.95	
	04: Super Programs 4	33	£4.95	
	05: Super Programs 5	34	£4.95	
	06: Super Programs 6	35	£4.95	
	07: Super Programs 7	36	£4.95	
	08: Super Programs 8	37	£4.95	
	09: Biorhythms	38	£8.95	
	10: Backgammon	39	£5.95	
	11: Chess	40	£8.95	
	12: Fantasy Games	41	£4.75	
	13: Space Raiders & Bomber	42	£3.95	
	14: Flight Simulation	43	£5.95	
	15: English Literature 1	44	£6.95	

Qty	Cassette	Code	Item price	Total
	02: English Literature 2	45	£6.95	
	03: Geography 1	46	£6.95	
	04: History 1	47	£6.95	
	05: Mathematics 1	48	£6.95	
	06: Music 1	49	£6.95	
	07: Inventions 1	50	£6.95	
	08: Spelling 1	51	£6.95	
	09: Collector's Pack	52	£9.95	
	10: Club Record Controller	53	£9.95	
	11: VU-CALC	54	£7.95	
	12: VU-FILE	55	£7.95	
	ZX 16K RAM pack	16	£29.95	
	ZX Printer	27	£59.95	
	Post & packing - only 1 ordering hardware		£2.95	

TOTAL £

I enclose a cheque/postal order to Sinclair Research Ltd for £

Please charge my *Access/Barclaycard/Trustcard no.

*Please delete as applicable.

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New From Fuller FD System for the **ZX SPECTRUM**



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